Per cent. carbon.	The aspect of the spectrum.
1·2 } 1·1 }	The group ϵ just disappearing, the group δ very distinct.
1·0	The group δ a little fainter.
0·90	,, ,, yet fainter.
0·80	δ_3 and δ_4 fainter than other bands of the group.
0·75	δ_3 and δ_4 indistinct.
0·70	δ_3 just disappeared.
0·55	δ_3 and δ_4 are away.
0·40	The group δ away.
0·20	The group δ_1 γ_3, β_2 and generally γ_2 are away.

Subsequently no constant values were obtained, but on judging from similar spectra, on one occasion the metal contained 0·95, and another time 0·65 per cent. of carbon. The sole change that had been made was due to the slit of the instrument having been cleaned. This indicates that it may be of some importance to have this so regulated by a micrometer-screw that its width may be accurately determined at any time during a series of observations. The temperature of the iron of the converter may have some influence upon the disappearance of the bands, as similarly bands already described appear during the "blow" more distinctly if the temperature is high than if it is low.

"Remarks on the Origin of some of the Lines and Bands observed in the Spectra from Swedish Bessemer Works." By W. N. Hartley, F.R.S. Received April 1,—Read June 20, 1895.

The observations made at various Bessemer steel works in Sweden, as described in the preceding paper, are of particular interest, owing to the number of accurate measurements of bands and lines observed in different spectra of the flame during the progress of the "blow" when different varieties of metal are operated upon.

As the paper was written, as I have been informed by Mr. Lundström, about nine years ago, the author was at a disadvantage in being unable to compare all his measurements with flame spectra of known origin at high temperatures. Fallacious deductions are liable to be drawn by referring bands and lines in the Bessemer flame to only such spectra as have been obtained by the arc or spark. This was found to be the case in the study of oxyhydrogen blow-pipe spectra ('Phil. Trans.,' vol. 185, A, p. 161); hence I propose to offer

suggestions as to the origin of some of the bands and lines measured by Mr. Lundström.

The Nykroppa Spectrum.

λ.		λ.		Remarks.
6079	is probably	6075	CaO	These have all been observed in oxyhydrogen flame spectra.
6028	,,	6026	Na	
5712	,,	5688	Na	
5629	,,	5619	Fe	
5532	,,	5537	Fe	
5338	,,	5340	K	
5135	,,	5138	C	

Three bands in the green have been referred to phosphorus; but it is very difficult to admit that this element, in any form, can give rise to their appearance in the Bessemer flame. I have shown that phosphorus pentoxide yields a spectrum of its own, and is not dissociated in the oxyhydrogen flame; also that ferrous phosphate yields the bands of phosphorus pentoxide.

It is just possible that when the blast is charged with moisture a compound of phosphorus and hydrogen may be formed in the presence of much carbon; but, on the other hand, such compounds show the green bands of phosphorus only when the flame is cooled, and, as that which issues from the mouth of the converter is intensely hot, the bands are scarcely likely to be visible.

In parallel columns are here given—

I. Measurements of the bands of phosphorus.
II. Measurements of bands in the Bessemer flame spectrum of Långshyttan.
III. Bands to which it is suggested the Bessemer flame spectrum should be referred.

I. Phosphorus. λ.	II. Bessemer. λ.	III. Reference bands. λ.
5590	5581—5608	Probably 5608 Mn.
5255	5264	,, 5270 Mn.
5110	5103	,, 5110 Fe.

The Spectrum of the "Blue Flame."

Several of the lines and bands measured in the spectrum of the "blue flame" are easily reproduced in the oxyhydrogen flame, others, however, which have been observed in the spectra which I have photographed at the Crewe Works of the London and North-Western

Railway cannot with certainty be assigned to any particular element.

The following are some of the lines and bands referred to :—

Spectrum of the "blue flame." λ.		λ.	Remarks.
5709	is probably	5712	Mn.
5451	,,	5456	Mn. 5452 Crewe.
5339	,,	5338	Mn.
4986	,,	4983·5	Na.
4854	,,	4853	Mn from MnO_2.
4809	,,	4808·2	Crewe spectrum. Li?
4748	,,	4749·5	Mn.
4655	,,	4656	Mn.
4540	,,	4540	Crewe spectrum. Fe.
4492	,,	4493	Crewe spectrum. Fe.

Certain lines or bands in the spectrum of the "blue flame" were found to coincide with, or closely approximate some of the principal bands measured by Salet in the spectrum of silicon, namely, 567, 545, 522, 501, and 487·5.

A measurement corresponding to the first of these, described as 5672, edge of band intense, was observed by me on plate 8, Crewe, in the first spectrum only; another measurement of the same band on plate 6, Crewe, gave 5670. The origin of this band I have been unable to ascertain.

Of the remaining lines in the "blue flame":—

λ.		λ.	Remarks.
545	is probably	5445	Mn. Two lines, 5455 and 5452, in the Crewe spectrum approximate to 5454·7, which, according to Fievez and Thalén, is Fe.
522	,,	5227	Mn_2O_3. Lundström. Other lines corresponding to this are 5231 Crewe, 3rd spectrum, plate 6, and 5217 Crewe, 3rd spectrum, plate 8. There is an iron line at 5231.
501	,,	5018	Mn_2O_3.
487·5	,,	4862	Band coincident with the solar line F.

It is, I believe, much more probable that silicon hydride is the cause of the bands in the spectrum, than that phosphorus is the origin of the three bands in the Långshyttan spectrum.

Neither silica, a silicate, nor a silicide, such as silico-spiegel, yields bands or lines of silicon in the oxyhydrogen flame, but a highly siliceous pig-iron, charged with much carbon, may react with water-vapour contained in the blast during damp weather so as to evolve carbon monoxide and the compound silicon hydride. This, of course,

would readily burn in the air, and, while exhibiting the silicon bands, it would also display the lines of hydrogen, particularly the C, F, and H lines, the red C being the most conspicuous. Further observations on this spectrum are desirable, and the hydrogen lines should be particularly looked for; but on the whole I am inclined to believe that Mr. Lundström's deduction as to the origin of the "blue flame" being caused by silicon is substantially correct, if it be understood that the silicon is in combination with hydrogen. Many of the lines and bands in the Ulfshytte spectrum, which have not been identified, have been observed in the Crewe spectra; but their origin still remains a mystery.

"On the Variable Stars of the δ Cephei Class." By J. NORMAN LOCKYER, C.B., F.R.S. Received November 9,—Read November 21, 1895.

Introductory.

Professor E. C. Pickering, in his classification of the variable stars, which is based on a study of the light curves,* recognises two classes of variables having short periods. His Class IV includes those variables, exemplified by δ Cephei and β Lyræ, in which the light changes are not of very great range, and continue throughout the period. Class V comprises those like Algol in which there is a temporary reduction of light at minimum, produced by the eclipse of the bright star by a relatively dark companion; this explanation has since been established by spectroscopic investigations, which have shown that there is no change in the spectrum at minimum, and that there is an orbital movement of corresponding period.

Both these classes are sharply distinguished from the variables of the Mira type, which form Pickering's Class II. In this class of variables, as in Class IV, the light changes go on throughout the period, but the range of variation is generally much greater, and the periods are reckoned by months instead of days. The variability is associated in this case with a fluted spectrum (Group II), and in a former communication I have shown that the phenomena can be explained on the supposition that there is one swarm (or more) of meteorites revolving in an elliptic orbit round a central swarm; an *increase* of light at maximum occurring at periastron when the number of collisions is greatest.†

It is probable that the variables of Class IV will require further subdivision, when their spectra have been more fully investigated.

* 'Amer. Acad. Proc.,' vol. 16, p. 17.

† 'Roy. Soc. Proc.,' vol. 43, p. 154, 1887.